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Comparison of Relative Errors in Snow Maps in North America and Eurasia in 2001-02

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ABSTRACT

Results of this investigation confirm previous results by several authors (see Armstrong and Brodzik, 1999; Hall et al., in press) that correspondence between the MODIS and SSM/I-derived snow maps improves as the winter progresses. Early in the season, the SSM/I snow mapping algorithms are unable to identify shallow and wet snow as snow cover, while the MODIS snow maps perform well under those circumstances, but cannot map snow through clouds and cannot provide estimates of SWE. By mid winter when the snowpack is deeper, temperatures are colder, and liquid water in the snowpack is minimal, the agreement between MODIS- and SSM/I-derived snow maps improves. For North America, the difference averaged about 5% for maps examined in February of 2002, and for Eurasia (eastern Asia), the difference was less than 10% in January of 2001.

1. INTRODUCTION

Accurate snow maps are required for hydrological and climatological applications and by operational agencies to monitor snow conditions, and to predict spring water supply and flood conditions. Visible/near-infrared-based snow maps have the advantage of high spatial and temporal resolution (tens of meters and daily coverage) and the ability to measure albedo, while passive-microwave snow maps have a high temporal resolution, the spatial resolution is poor (on the order of tens of km). However, passive microwave data are indifferent to clouds and darkness, but visible data are limited to daytime operation, and clouds limit their mapping efficacy. In this study, Moderate Resolution Imaging Spectroradiometer (MODIS) and Special Sensor Microwave Imager (SSMI) snow data are examined and compared during the winter season in North America and Eurasia.

Since November 1978, the Scanning Multichannel Microwave Radiometer (SMMR) instrument on the Nimbus-7 satellite, and the SSMI on the Defense Meteorological Satellite Program (DMSP) series of satellites have been acquiring passive microwave data that can be used to estimate both snow extent and snow water equivalent (snow depth). In addition, passive-microwave sensors have the capability to estimate snow depth and snow-water equivalent (SWE) as well as snow extent.

NASA's MODIS sensor on-board the Terra and Aqua satellites, and the Advanced Microwave Scanning Radiometer (AMSR) currently all produce snow maps. The Terra satellite, launched in December of 1999, has the MODIS as part of its payload of five instruments, while the Aqua satellite, launched in May of 2002, contains a second MODIS instrument, the AMSR-E and four other instruments. Snow maps have